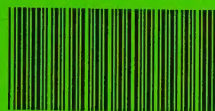


6



ADVANCE

MP MASTER



MA22688



Bench Power Supplies PP41-42

Instruction Manual



**ADVANCE
INDUSTRIAL
ELECTRONICS**

Raynham Road
Bishops Stortford
Herts England
Telephone Bishops Stortford 55155
Telex 81510

Division of **ADVANCE ELECTRONICS LIMITED**

Manual Part No. 50755

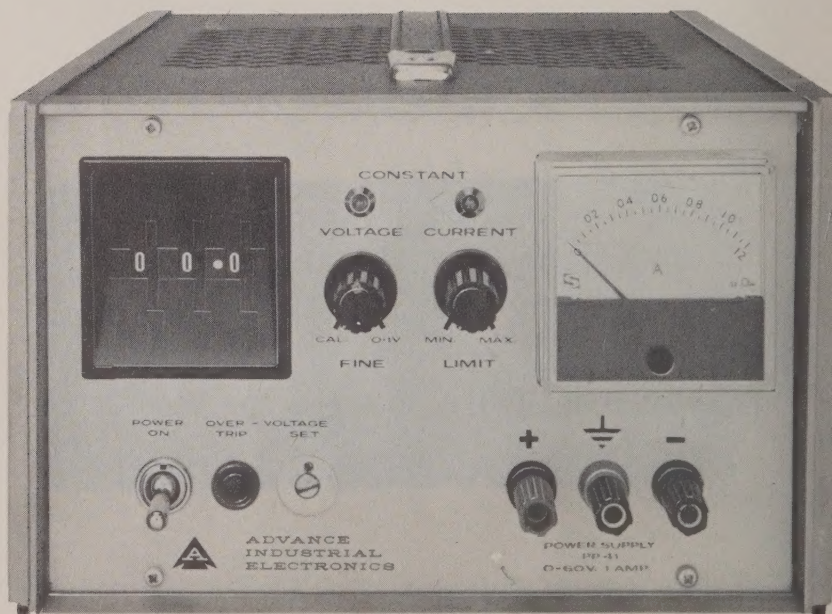


Fig. 1 Power Supply Type PP41

SECTION 1	INTRODUCTION	5
SECTION 2	SPECIFICATION	6
SECTION 3	OPERATION	8
3.1	Dimensions and Weights	8
3.2	AC Supply and Preliminary Checks	8
3.3	Resetting the Output Voltage	11
3.4	Resetting the Output Current	11
3.5	Resetting the Overvoltage Protection	11
3.6	Programming Current and Voltage	11
3.7	Parallel and Series Operation	12
3.8	Four-terminal Sensing	13
SECTION 4	CIRCUIT DESCRIPTION	15
4.1	General	15
4.2	Supply Rectification and Smoothing	16
4.3	Pre-Regulator	16
4.4	Series Regulator	17
4.5	Bridge Reference Source	17
4.6	Stabilisation of Auxiliary Supply	17
4.7	Voltage Control Bridge	18
4.8	Voltage Control	18
4.9	Current Control Bridge	18
4.10	Current Control	18
4.11	Mode of Operation	19
4.12	Overvoltage Protection	20
4.13	External Programming	21
SECTION 5	MAINTENANCE	23
5.1	Access to Components	23
5.2	Replacement of Printed Circuit Boards	23
5.3	Fault Finding	23
SECTION 6	COMPONENT LIST AND ILLUSTRATIONS	25
SECTION 7	GUARANTEE AND SERVICE FACILITIES	28

TABLES

Table 1	Dimensions and Weights	8
Table 2	Transformer Primary Connections 100 – 125V	9
Table 3	Transformer Primary Connections 200 – 250V	10
Table 4	Fuse Rating	10
Table 5	Permissible Lead Lengths	14
Table 6	Fault Finding Chart	23

ILLUSTRATIONS

Fig. 1	Power Supply Type PP41	2
Fig. 2	Transformer Primary Connections for 110V	8
Fig. 3	Transformer Primary Connections for 240V	9
Fig. 4	Parallel Operation	12
Fig. 5	Four-terminal sensing	13
Fig. 6	Four-terminal sensing (parallel)	13
Fig. 7	Functional Diagram of Power Unit	15
Fig. 8	The Crossover Load	19
Fig. 9	Current Control Circuit	22
Fig. 10	Circuit Diagram and Component List	25
Fig. 11	Circuit Diagram and Component List	27

The PP41 and PP42 represent a new range of advanced design, low dissipation pre-regulated power supplies, which are most suitable for laboratory and industrial use.

The range provides output voltages 0 - 60 volts in 0.1 volt steps selected by a front panel digital thumbwheel control. An additional 0 - 0.1V variable control with switched 'calibrate' position is also provided.

Current ratings are 1A and 3A respectively.

The voltage and current levels may be varied manually by use of front panel controls, or externally by means of the programming facilities located at the rear of the unit.

- Digital Voltage setting
- Overvoltage protection with indicator
- Programmable on voltage and current
- Mode indication
- 10,000:1 Stability

INPUT VOLTAGE

100, 105, 110, 115, 120, 125, 200, 220, 230, 240, 250V $\pm 10\%$ 48 - 65Hz.

VOLTAGE LIMIT SETTING

3 decade setting of voltage in 10V, 1V and 0.1V steps. An additional 0.1V continuous control at any point of the range with switched 'cal' position.

CALIBRATION ACCURACY

$\pm 0.5\%$ or 20mV (whichever is greater) at 25°C.

CURRENT LIMIT SETTING

A continuous control over the current range 5 - 105% of full load current with meter indication of output current.

METER ACCURACY

$\pm 2\%$ F S D.

VOLTAGE MODE**LINE REGULATION**

Less than $\pm (0.001\% + 30\mu\text{V})$ for a $\pm 10\%$ AC line variation at any specified transformer tap.

LOAD REGULATION

Less than $(0.02\% + 1\text{mV})$ for a zero to full load current change.

RIPPLE

Less than 400 μV R M S.

TEMPERATURE COEFFICIENT

Less than $(0.015\% + 100\mu\text{V})$ per °C on internal programme

Less than $(0.013\% + 100\mu\text{V})$ per °C on external programme
plus coefficient of programming resistor.

OUTPUT IMPEDANCE

Less than 0.25 Ω at 100KHz.

RECOVERY TIME

For a full load step change the output voltage will recover in approximately 20 μs to within 10mV of the regulation band.

CURRENT MODE

LINE REGULATION

Less than $\pm(0.02\% + 200\mu\text{A})$ for a $\pm 10\%$ AC line variation at any current in the range of 5% to 100% of full load rated current.

LOAD REGULATION

Less than $(0.1\% + 2\text{mA})$ for a zero to full load voltage change.

RIPPLE

Less than 0.1% peak to peak of the set output current.

TEMPERATURE COEFFICIENT

Less than 0.1% (of maximum rated output current) per $^{\circ}\text{C}$.

PROTECTION

OVER CURRENT PROTECTION

Constant current overload protection which is variable from 5% to 105% of full load.

OVER VOLTAGE PROTECTION

Overvoltage protection by high speed S C R crowbar with fuse. The trip voltage may be varied from 1.5V to 64V by means of preset front panel control.

REMOTE CONTROL FACILITIES

VOLTAGE SENSING

Voltage programming resistance $100\Omega/\text{V} \pm 1\%$.

CURRENT PROGRAMMING

Programming resistances are as follows:

PP41 $1000\Omega/\text{A} \pm 2\%$; PP42 $333/\text{A} \pm 2\%$.

MODE INDICATION

Auxiliary c/o contacts available on rear panel, terminals 11, 12 and 13.

TEMPERATURE RANGE

-10°C to $+50^{\circ}\text{C}$.

INSULATION

Floating output must not exceed $\pm 250\text{V}$ DC from ground. Input tested 500V DC live to ground, and live to output greater than 100M ohms.

OUTPUT VOLTAGES AND CURRENTS		
Model	PP41	PP42
Voltage	0 - 60V	0 - 60V
Current	1A	3A

3.1 OVERALL DIMENSIONS AND WEIGHTS

Table 1

Model	PP41	PP42
Width	8½” (21.6cm)	8½” (21.6cm)
Length	10” (25.4cm)	14½” (36.8cm)
Height	5¾ ” (14.6cm)	5¾ ” (14.6cm)
Weight	14lb (6.4Kg)	22¾lb (10.4Kg)

3.2 AC SUPPLY

Slide top cover of unit back by removing retaining screw at the rear of the unit. Verify that the connections to the primary of supply transformer T200 correspond to the voltage of the local supply and that the supply fuse FS1 is correct for the unit in use (see Table 4).

The primary connections of T200 should be paralleled when the local supply is 100 to 125V. Figure 2 shows the connections for a 100V supply and Table 2 gives the connections for supplies between 100 and 125V.

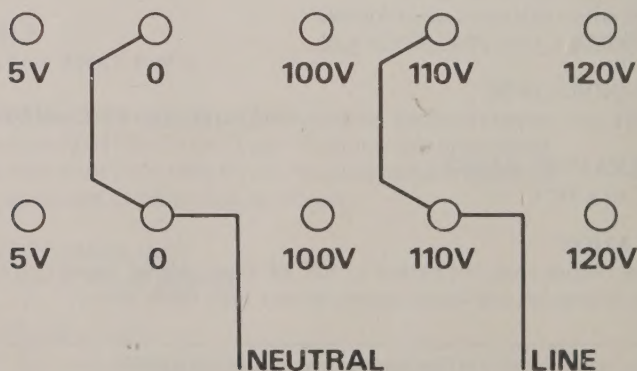


Fig. 2 Transformer Primary Connections for 110V

Table 2 Transformer Primary Connections 100 - 125V

Supply	Neutral (Black)	Line (Violet)	Neutral Link Between	Line Link Between
100V	0	100	0 - 0	100 - 100
105V	5	100	5 - 5	100 - 100
110V	0	110	0 - 0	110 - 110
115V	5	110	5 - 5	110 - 110
120V	0	120	0 - 0	120 - 120
125V	5	120	5 - 5	120 - 120

When a 200 to 250V supply is available, the primary connections of T200 should be made in series. Figure 3 shows the series connections to be made for a 240V supply and Table 3 gives the connections for supplies between 200 and 250V.

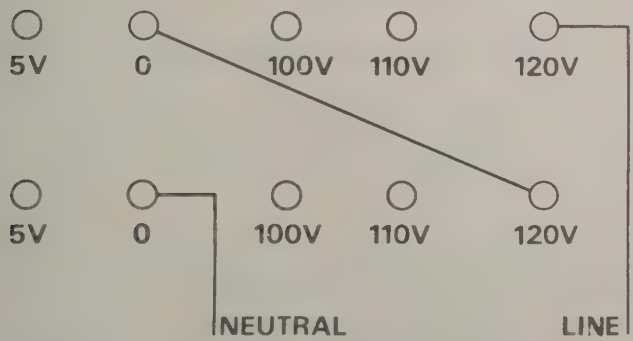


Fig. 3 Transformer Primary Connections for 240V

Table 3 Transformer Primary Connections 200 - 250V

Supply	Neutral (Black)	Line (Violet)	Diagonal Link Between
200	0	100	0 - 100
210	5	100	5 - 100
220	0	110	0 - 110
230	5	110	5 - 100
240	0	120	0 - 120
250	5	120	5 - 120

Table 4 Fuse Rating

Power Supply Unit	FS1 200 - 250V		FS1 100 - 125V		FS2 DC Fuse	
	Rating	Size	Rating	Size	Rating	Size
PP41	2.5A	00	4A	00	2.5A	00
PP42	7A	0	10A	0	5A	0

PRELIMINARY CHECKS – Before applying AC supply to the unit, ensure that the correct fuses are fitted as specified in Table 4. Check that the links situated on the rear terminal block are connected in the ‘Front Panel’ voltage sensing position.

NOTE If these links are not made, the unit will not operate satisfactorily. When the preliminary checks have been completed, connect the line supply.

- Line to Brown wire of input lead
- Neutral to Blue wire of input lead
- Ground to Green/Yellow wire of input lead

3.3 RESETTING THE OUTPUT VOLTAGE

When setting up a specified output voltage, the following conditions should be observed:-

1. The current limit control on the front panel should be fully clockwise.
2. The overvoltage trip control should be in the fully clockwise position.
3. The Voltage Fine control switched to 'cal' position. The output voltage of the unit will then be as indicated by the digital switches, so long as the voltage mode lamp is on. The constant current level and overvoltage protection may then be set as shown in section 3.4 and 3.5.

3.4 RESETTING THE OUTPUT CURRENT

The constant current limit is set by the Current Limit Control positioned on the front panel. The control may be set to any value of current within the range 5% to 105% of the maximum rated current of the unit.

To set the control to the required level, it is necessary that the unit is operated in the current limit mode. This may be conveniently carried out by connecting a short circuit across the output terminals. Current mode operation is confirmed by the current mode lamp being on and the control may be then adjusted to the required level as indicated by the ammeter.

3.5 RESETTING THE OVERVOLTAGE PROTECTION

1. Set the overvoltage trip to fully clockwise position.
2. Set the digital switch to the required voltage level at which the protective circuit is to operate (usually 10% above working voltage)
3. Switch on AC supply and gradually turn voltage trip control anticlockwise until trip indicator lights.
4. Turn off the AC supply and reduce the output voltage level by means of the digital switch.
5. Switch on the AC supply and by gradually increasing output voltage check that the overvoltage trip operates at the required level. Repeat procedure if necessary.

3.6 PROGRAMMING CURRENT AND VOLTAGE

Voltage and Current protection levels can be controlled externally. To utilise this facility it is necessary to remove terminal links (which disconnect the internal controls from circuit) and connect external resistors by means of remote lines if necessary. By using resistors whose values correspond to the voltage or current required, both voltage control and current control can be effected remotely.

NOTE If remote lines are used, their resistance is to be included in the value

of the programming resistor and they should be shielded from stray electromagnetic fields to minimise 'noise' pick-up.

3.6.1 (a) VOLTAGE CONTROL

To connect the unit for external programming of voltage, the procedure is as follows:-

1. Switch off AC supply.
2. Disconnect the link across terminals 4 and 5 on rear panel.
3. Connect the external programme resistor between terminals 4 and 10 (See section 2 for value).
4. Switch on the AC supply.

3.6.1 (b) CURRENT CONTROL

For external control of current RV 200 is disconnected from circuit and replaced by an external potentiometer or fixed resistor. The level of current is related to the value of the external resistance by the Ω A scale factor which is given in Section 2 for each of the power supplies. To connect the unit for external programming of current, the procedure is as follows:-

1. Switch off the AC supply.
2. Disconnect the link across terminals 1 and 2 on the rear panel terminal block.
3. Connect the external programme resistor to terminals 2 and 3.
4. Switch on the AC supply.

3.7 PARALLEL AND SERIES OPERATION

The power supplies incorporate rectified diodes and thyristors which permit two similar units to be connected in parallel or four units in series operation.

For best voltage regulation the terminal labelled 'P' on the circuit (terminal 6 on rear panel) on each unit should be returned to a common point and four terminal sensing used as described in section 3.8 - but this is not essential.

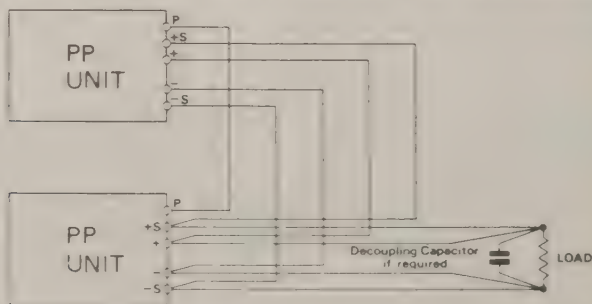


Fig. 4 Parallel Operation

3.8 FOUR TERMINAL SENSING

Where long external output leads are used, four-terminal sensing is provided to enable the load voltage regulation of the power supply to be maintained at the load connections. The two links between the +ve sense and +ve output (terminals 7 and 8) and the -ve output and -ve sense (terminals 9 and 10) should be removed and connections made as shown in Figure 5. These output connections should be run together and a decoupling capacitor, similar to C207 in the power supply, connected at the load terminals if the high frequency output impedance is to be maintained. Parallel connection should be made as shown in Figure 6.

The maximum permissible voltage drop in the external leads when using four-terminal sensing is 0.5V total in both leads i.e. 0.25V in each lead +ve and -ve or 0.5V in one supply lead with a ground return of negligible resistance.

The total permissible length of lead for 0.5V drop is listed in Table 5, for various wire sizes and current ratings.

NOTE That this is the total permissible loop length 'go and return' and that the power supply can only be situated at half this distance from the load for a two wire +ve and -ve lead system.

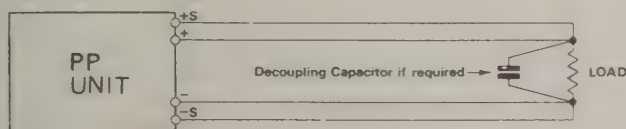


Fig. 5 Four-terminal sensing

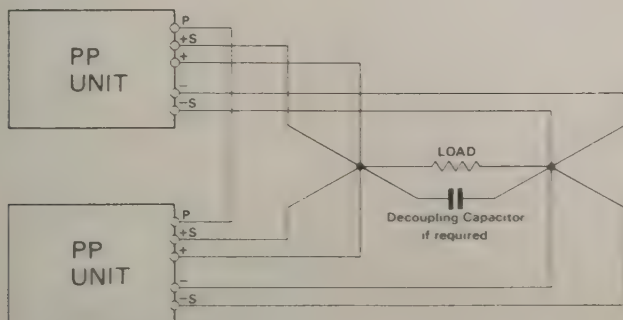


Fig. 6 Four-terminal sensing (parallel)

Table 5 Permissible lead length for Four-terminal sensing

Wire Size	Lead Length feet and metres			
	PP41		PP42	
	ft	m	ft	m
7/0076	19	6		
14/0076	38	12	13	4
23/0076	60	18	20	6
40/0076			68	21

4.1 GENERAL

A simplified functional diagram of the circuitry of the power unit is shown in Figure 7. The voltage and current modes of operation are controlled by two independent bridge circuits. Any variation of load current or output voltage produces an out-of-balance condition of the associated bridge. The output of the bridge is applied to a comparator amplifier whose output is fed into a mode gate. The output of the mode gate controls the output resistance of a series regulator which restores the original mode condition. The circuit cannot operate in both modes simultaneously, and only the control signal from the bridge corresponding to the mode of operation passes through the gate.

Crossover from one mode to another is automatic, and the point of crossover is determined by the settings of the voltage selector switch (R250-R276) and current limit control (RV200).

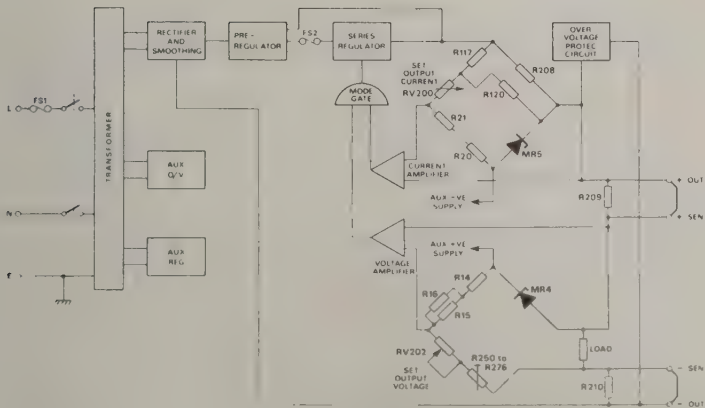


Fig. 7 Functional Diagram of Power Unit

An auxiliary stabilised power supply is also incorporated. This supplies the bridge circuits and the comparator amplifiers; to simplify the functional diagram, the output connections of the auxiliary supply are not shown. Over-voltage protection is afforded by a sensing circuit connected across the stabilised output terminals. The level at which the circuit operates is controlled by the setting of a potentiometer. A simple auxiliary supply also provides for the overvoltage circuit. The pre-regulator section maintains the unregulated input voltage on input filter capacitor C203 at a controlled level above the output voltage in order to lower the power dissipation in the series regulator.

4.2 SUPPLY RECTIFICATION AND SMOOTHING

The AC input within the range 100V - 125V and 200V - 250V, 48 - 65Hz is applied to the primary of T200 via AC supply switch S200 and fuse FS1. Interconnection of the primary terminals for different voltage supplies is given in Section 3.2.

The transformer has three secondary windings. The output voltage derived from one winding provides the auxiliary supply for the regulator circuit and another winding provides the auxiliary supply for the overvoltage circuit. The third and main winding is applied to the bridge rectifier MR200 and smoothed by C201. The resultant 'raw' DC is then pre-regulated before being controlled by the series regulator.

4.3 PRE-REGULATOR

The purpose of the pre-regulator section is to maintain a voltage across C203 which is a controlled level above the voltage required at the output terminals. Transistors VT50, VT51, 52, 53 and associated circuitry produce a high frequency sawtooth waveform across C53. The DC level at any point of the waveform is compared with the voltage level across R64 by transistor VT54. When the respective voltage levels are such that VT54 conducts, VT57, 58 and VT201 also conduct. By varying the voltage level across R64 therefore, the point in the cycle at which the regulator conducts can be varied. When the combined voltage drop across R204 and VT203 exceeds the reference voltage of D53, VT55 will conduct, which in turn drives VT56 and increases the voltage level across R64. By this method the conduction period in each cycle can be varied and hence the mean voltage level across smoothing capacitor C203 is controlled at the required level. The voltage drop across R204 is only significant during initial switch on conditions when it monitors the inrush current of C203. The signal current thus produced is fed back into the sense circuit which in turn controls the pre-regulator current to a safe value.

An internal overvoltage protection circuit consisting of Thyristor CSR201, Resistor R214 and Zener reference Diodes D211, D212 and D213 detects an

overvoltage across capacitor C203. Should a fault condition occur in the pre-regulator circuit, an excessive voltage could appear across C203. This would be detected by the protection circuit and CSR201 would conduct heavily, thus blowing the AC input fuse FS1.

4.4 SERIES REGULATOR

The series regulator contains transistor VT202 and transistor VT203, (which may consist of several transistors in parallel) arranged in a Darlington-pair configuration. An increasing positive signal applied to the base of VT202 decreases the output resistance of the circuit; conversely, a decreasing signal increases the output resistance. Each transistor in VT203 has a separate resistor in the emitter circuit to provide current sharing between transistors. The voltage developed by the flow of load current through the resistor R208 is connected across a common potential divider network of resistor R117 and R120 to provide a voltage signal proportional to the output current which is standardised at 0.85V for 100% output current.

4.5 BRIDGE REFERENCE SOURCES

Two zener diodes, D4 and D5 are used as reference sources in the voltage and current bridges, respectively.

These diodes are connected in series with the resistor network of R10, R11, and R12 across the auxiliary voltage supply line, and D4 is also used as the reference for the stabilising circuitry of the auxiliary voltage supply. The flow of current through the two diodes is determined by accurate adjustment of the value of the resistor network. This level of current is maintained by the stabilised auxiliary voltage.

4.6 STABILISATION OF THE AUXILIARY SUPPLY

Stabilisation is effected by the sensing network R5, R6 and R9 and the associated circuitry of the transistors VT1 to VT4. A proportion of any change in the auxiliary voltage is fed to the base of VT3 which is in a long-tail pair configuration with VT4. Assume that the voltage across the sensing network tends to rise. An increase in the voltage drop across R6 occurs. This increases the base voltage of VT3 which is compared with the fixed base voltage of VT4 established by D4. The resultant positive increase of the collector potential of VT4 decreases the conduction of VT2; the emitter voltage of VT2 is fixed by Zener diode D3. As a result, the decreased conduction of VT2 reduces the base drive of the series regulator transistor VT1. Thus, the resistance of VT1 increases and counteracts the initial tendency of the output voltage to rise. Resistor R4 ensures initial conduction of VT1.

4.7 VOLTAGE CONTROL BRIDGE

The circuitry which senses any tendency of the output voltage to change is shown in a bridge configuration in Figure 7 and the Circuit Diagram Figure 10. Any unbalance of the bridge is detected by the long tail pair VT5 and VT6 which operate as the voltage comparator amplifier. The two diodes, D6 and D7, connected from the base of VT5 to the base of VT6 protect the two transistors against heavy discharge current from C207 if the capacitor is in a charged condition when the sense lines are connected.

As shown in Figure 7 the resistor network R14, R15 and R16 and RV202, R250 to R276 form two arms of the voltage control bridge. When the bridge is balanced the voltage condition is as follows:-

$$\begin{aligned} \frac{V_{D4}}{V_{(RV202+R250 \text{ to } R276)}} &= \frac{V_{(R14+R15/R16)}}{+ = V_{OUT}} \end{aligned}$$

For V_{OUT} to equal $V_{(RV202+R250 \text{ to } R276)}$ at all settings of RV202 and R250 to R276 the output voltage must be a direct function of the resistance of RV202 and R250 to R276.

4.8 VOLTAGE CONTROL

With the bridge balanced, the circuit will remain in equilibrium until the output voltage tends to change. Any change in the output voltage across the load is fed back, via the positive sense line to the base of VT6 where it is compared with the base voltage of VT5. The resultant change of level of the collector voltage of VT5 is applied to D8 which with D9 forms the mode gate. A change in signal to D8 results in a change of output resistance of the series regulator in such a direction as to counteract the original change in voltage.

4.9 CURRENT CONTROL BRIDGE

The circuitry forms a bridge configuration as shown in Figure 8 and the circuit diagrams Figure 10 and 11.

4.10 CURRENT CONTROL

With the bridge balanced, the circuit will remain in equilibrium until the output current tends to change. Any change of load current changes the voltage drop across resistors R119, R120 with respect to the base of VT8. A proportion of this voltage change is applied via RV200 to the base of VT7. The resultant change in the level of the collector voltage of VT8 is then applied to D9 which with D8 forms the mode gate. A change in signal to D9 results in a change of output resistance of the series regulator in such a direction as to counteract the original change in current.

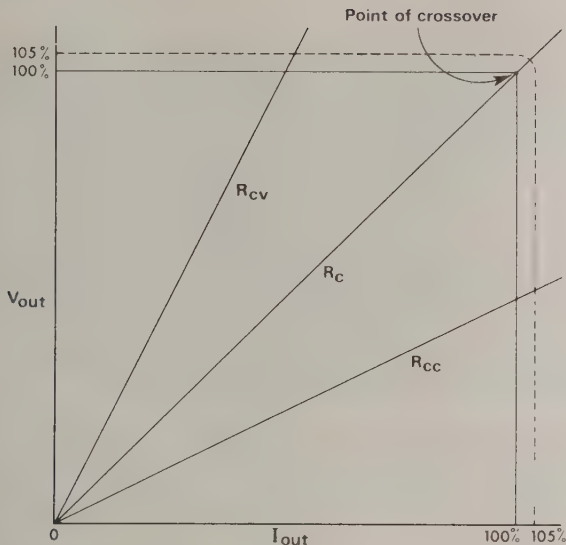


Fig. 8 The Crossover Load

4.11 MODE OF OPERATION

The mode of operation of the power supply is determined by the load conditions and the setting of the voltage and current controls. Automatic crossover from one mode to the other is depicted in Figure 8 and occurs at the value of load resistor designated R_c . The value (in ohms) of the load resistor R_c is obtained by dividing the voltage (volts) set by R250/276 and the current (amps) set by RV200. When the power supply is connected to any load R_{cv} whose resistance is more than R_c the mode of operation is constant voltage. When the resistance of the load decreases to any value R_{cc} below R_c the mode of operation is constant current.

During either mode of operation, both comparator amplifiers produce output voltages which are applied to two diodes in the mode gate. Diode D8 is controlled by the output of the voltage comparator (collector of VT5), and diode D9 is controlled by the output of the current comparator (collector of VT8). The diode which conducts is the one receiving the higher output voltage. The output from the conducting diode is amplified by VT9 and then applied, via the emitter-follower VT10, to the series regulator. Except for a brief transitional period at crossover, both diodes do not conduct simultaneously; thus, it is always the higher output of the two comparators which controls the resistance of the series regulator.

NOTE That VT9 introduces polarity inversion, and a high positive output

from the mode gate produces high resistance of the series regulator.

The crossover action is best understood by considering the operation of the control circuits as the resistance of the load is decreased from a high value of R_{CV} to a low value below R_C . At first, with a very low load current flowing, the collector voltage of VT8 is very low because the voltage developed across R119/R120 is low, and the resultant low base voltage of VT7 allows VT8 to conduct heavily. At the same time, the collector voltage of VT5 is high, because with low load current the stabilised output voltage tends to rise, but is held at its predetermined level by heavy conduction of VT6 which results in a high positive potential at the collector of VT5. Thus, of the two signals applied to the mode gate, the signal from VT5 will take control and effect the high value of output resistance required of the series regulator.

As the resistance of the load is decreased, VT7 senses the increased voltage drop across R119/R120 and increases conduction. This decreases the conduction of VT8 and its collector potential rises. Simultaneously, the collector voltage of VT5 decreases in order to reduce the output resistance of the series regulator so that the higher load current may flow.

This action of the collector voltage of VT8 rising and that of VT5 falling as the resistance of the load decreases continues until at the crossover point the signal from VT8 takes control and a rapid transition from voltage mode to current mode occurs. The output supply voltage of the unit then falls to the level required to sustain the preset current level. This rapid transition from voltage mode to current mode provides overcurrent protection. Under constant voltage mode conditions the collector of VT5 is positive with respect to the collector of VT8, and VT106, 105 and 104 are non conducting. In constant current mode however, the collector of VT8 is positive, with respect to the collector of VT5, which drives VT106, 105 and 104 into conduction, and relay RL200 is energised. This switches the front panel lamps from a constant voltage to a constant current mode indication.

4.12 OVERVOLTAGE PROTECTION

The overvoltage protection circuit uses a long-tail pair comparator circuit containing transistors VT100 and VT101. The input to the base of VT101 is derived from R108 which with R106 and R107 forms a potential divider across the stabilised output supply. VT101 base voltage is compared with the base voltage of VT100 derived from the potentiometer RV201 connected across a zener diode reference source D102. The level at which overvoltage protection is required is by RV201, because this level is above the stabilised output voltage, the normal quiescent condition of the long-tail pair is such that VT100 is in conduction more than VT101. In practice, the overvoltage

limit is set approximately 10% above the level of the stabilised voltage. If the stabilised output voltage rises above the level set by RV201, transistor VT101 conducts and drives VT102 and VT103 into the ON state. This in turn fires CSR103 which produces a voltage drop across R111 and R112 to give front panel trip indication. At the same time thyristor CSR200 fires which short circuits the output of the power supply.

4.13 EXTERNAL PROGRAMMING

As explained during the description of the voltage and current control bridges, the balance conditions of the bridges are such that the following conditions exist.

1. The voltage across the resistance R250/276 (Digital switch) is equal to the output voltage. A change of resistance of R250/276 produces a directly proportional change of output voltage.
2. The voltage across the resistance of RV200 (Current Limit) is equal to the voltage across resistors R119 R120 which in turn, is directly proportional to output current. A change of resistance of RV200 produces a directly proportional change of output current.

The output current in passing through the R208's in parallel provides a voltage signal proportional to the output current which is divided down to a standard level by resistors R117 and R120 in parallel with R119.

This signal is compared with the voltage generated across RV200 by the current i_1 by the long-tail pair VT7 and VT8 operating as a comparator amplifier.

When the power unit is operating in the current mode the voltage amplifier is inoperative and the current bridge is in a balanced condition. The voltage conditions are then as follows:

$$I_{OUT} \times R208 \frac{R120/R119}{R117 + R120/R119} = i_1 \times RV200$$

$$\text{i.e. } I_{OUT} = K \times i_1 \times RV200$$

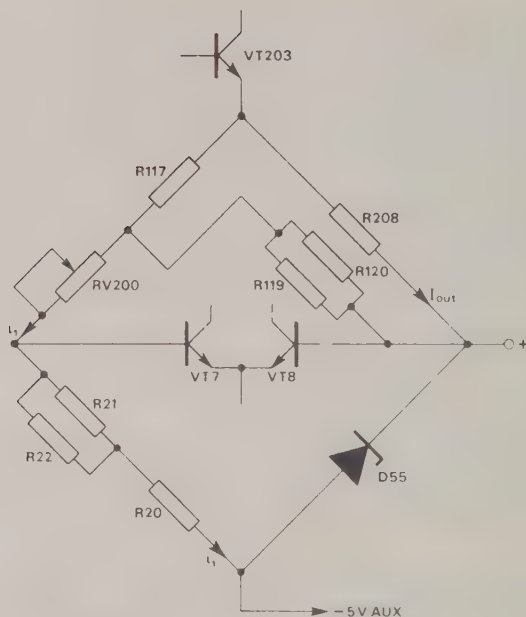


Fig. 9 Current Control Circuit

Thus, resistance-output voltage and resistance-output current relationships exist, and these are expressed as Ω/V and Ω/A scale factors, respectively. By disconnecting the variable resistors from circuit and in their place connecting - by remote line if necessary - fixed or variable resistors, the output voltage or current level can be set by altering the value of resistance. The advantage of this circuit facility is that without any monitoring or metering aid, the voltage and current level can be set simply by the value of resistance in circuit. The method of connecting the unit for external programming of output voltage, output current and overvoltage protection is detailed in Section 3.

5.1 ACCESS TO COMPONENTS

Access to the front panel components may be gained by removing the four front panel fixing screws, and hinging the front panel forward on the cableform. Access to the auxiliary board components including overvoltage and circuit may be obtained by sliding back the lower cover after removing the four screws holding the rear trim extrusions. The rear panel may then be hinged backwards by removing the two upper fixing screws and slackening off the two lower fixing screws at the side of the unit.

5.2 REPLACEMENT OF PRINTED CIRCUIT BOARD

The plug-in control boards may be if necessary removed for inspection by unscrewing the board retaining screws at the sides of the unit after removing the top cover and side panels. All plug-in control boards of the same part number are interchangeable.

All boards are available as spare parts, and the following Advance Part No. should be quoted when ordering:-

1. Series Regulator board

2. Pre-Regulator Board

3. Auxiliary Board

4. Over Voltage Board

Over Voltage Board
- Advance Part No. 50709 PP41, 42

Advance Part No. 50711 PP41, 42

Advance Part No. 50710 PP41, 42

Advance Part No. 51906 PP41

Advance Part No. 51860 PP42

5.3 FAULT FINDING

Determine the state of the output voltage on load and proceed as outlined in Table 6.

Table 6

Output Voltage	Fault	Action
No output	Fuse FS1 or FS2 blown	Change Fuse
	MR200 open circuit	Change MR200
	D207 - 210 open circuit (PP43 only)	Change D207 - 210
	VT203 Open circuit	Change VT203
	Printed plug in boards out of socket or faulty	Replace with new assemblies

Output Voltage	Fault	Action
Low Output	MR200 partially open Circuit	Change MR200
	CSR200 has fired	Check external circuit for over- voltage
	Overvoltage trip set too low	Readjust
High unstabilised output	Programme links o/c Printed Circuit plug- in boards faulty	Replace Replace with new assemblies
	VT203 short circuit	Change VT203 Check to see why CSR200 has not fired
High ripple	Series regulator plug- in board faulty	Replace with new assemblies
Excessive Output Current	Programming link (terminals 1 & 2) o/c	Replace
	Programming link resistor o/c	Replace

Table 6 (continued)

Fig. 10 Circuit Diagram and Component List

Fig. 11 Circuit Diagram and Component List



This instrument is guaranteed for a period of one year from its delivery to the purchaser, covering the replacement of defective parts other than tubes semiconductors and fuses. Tubes and semiconductors are subject to the manufacturers' guarantee.

We maintain comprehensive after sales facilities and the instrument can if necessary, be returned to our factory for servicing. The Type and Serial Number of the instrument should always be quoted, together with full details of any fault and the service required. The Service Department can also provide maintenance and repair information by telephone or letter.

Equipment, returned to us for servicing must be adequately packed, preferably in the special box supplied, and shipped with the transportation charges prepaid. We can accept no responsibility for instruments arriving damaged. Should the cause of failure during the guarantee period be due to misuse or abuse of the instrument, or if the guarantee has expired, the repair will be put in hand without delay and charged unless other instructions are received.

**OUR SALES, SERVICE AND ENGINEERING DEPARTMENTS ARE
READY TO ASSIST YOU AT ALL TIMES**



**ADVANCE
ELECTRONICS
LIMITED**

Hainault Essex England

Telephone 01-500 1000
Telegrams Attenuate Ilford
Telex 263785

MP MASTER



MA22688